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Modeling Virtual Classroom for Education in Engineering

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Abstract

Paper outlines an approach and method to modeling virtual classrooms primarily to establish an interactive learning environment mainly for education in virtual enginnering. Virtual classroom models Interment based curriculum, teaching procedures and student activities. Paper is organized as follows. It starts with an analysis of the virtual classroom from the point of view of the presented concept and approach. Following this the modeled classroom environment is outlined. Then model structure and entities are explained and associative based integration is emphasized. Finally, some concepts of application of modeling in virtual engineering environments are detailed and features of prospective application in practice are concluded.

1. Introduction

In recent years virtual classrooms were organized around well equipped Internet portals utilizing the dynamically developing Internet technology [1], [2]. However, these virtual classrooms do not utilize the similarly dynamically developing theory and methodology of computer modeling. Computer models are advanced and well-organized description of real world objects and are applied successfully where complexity of information environment results failing of conventional information description methods. The authors would like to contribute enhancement in application of advanced modeling methods for description of virtual classrooms. They proposed an approach to modeling of related virtual university activities [3].

Real teaching environments are represented in models. However, special features of their implementation in interactive Internet based environments are taken into account. The virtual classroom model proposed by the authors includes curriculum, teaching processes, credits, students and virtual laboratories.

Numerous advanced methods have been elaborated to assist learning by computers [4]. Valuable methodology has been resulted by activities in conventional distance learning [5]. Virtual university related research and teaching program development projects are around topics of cyberspace based campus and learning community as well as virtual classroom [6], [7], [8].

Paper is organized as follows. It starts with an analysis of the virtual classroom from the point of view of the presented concept and approach. Following this the modeled classroom environment is outlined. Then model structure and entities are explained and associative based integration is emphasized. Finally, some concepts of application of modeling in virtual engineering environments are detailed and features of prospective application in practice are concluded.

2. Approach to virtual classroom

The starting point for virtual classroom is an existing curriculum. Components of the virtual classroom are shown in Figure 1 Virtual classroom basically consists of curriculum, teaching processes, credits, students and virtual laboratories. Curriculum must be developed taking into account the special features of the virtual classroom. Curriculum is an organized learning experience. It describes content of a degree programme, provides conceptual structure and time frame to get that degree. The curriculum

in the proposed virtual classroom concept consists of courses. The course is an organized learning experience in an area of the education. Curriculum involves a choice of modules, blocks and topics. As for its structure, course is a sequence or network of modules. A module consists of blocks. A block involves topics. Core studies contain basic and essential knowledge. They are modules or blocks and can be build into courses or can exist individually upon student requests.

Teaching procedures are lectures, seminars, consultations, assignments and assessments. Other implementation based teaching procedures can be defined in classrooms. Credit information involves degrees and certificates defined by teaching requirements as well as financial conditions information. Students are featured by course, credit and fee related information. Virtual laboratories involve objects as software modules, arrangements of the objects and results of student work as assignments and degree works.

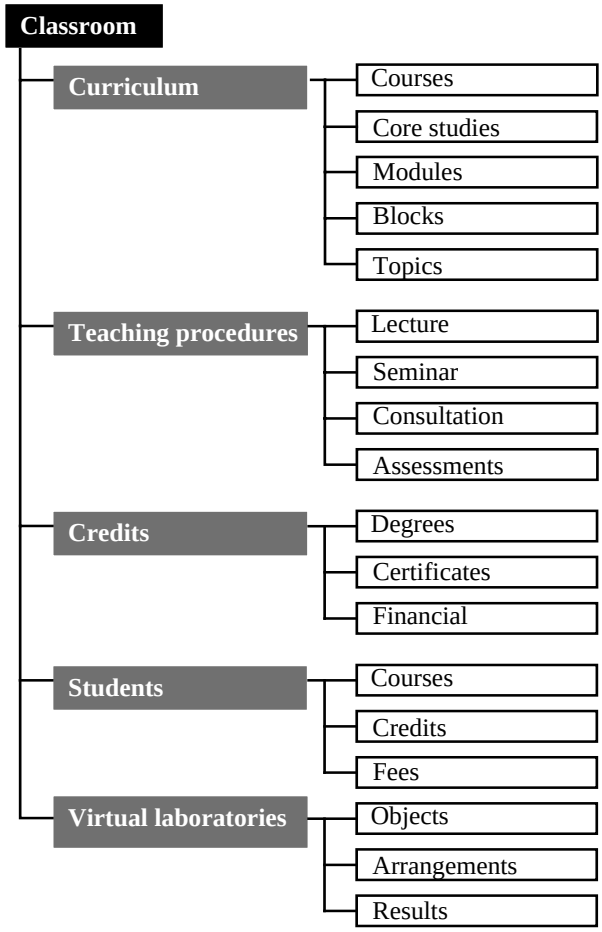

Figure 1. Components of the virtual classroom

Classroom is for students who require learning. Curriculum is for the content of the teaching. Credits together with requested course elements and their prerequisites are for degrees and certificates. Virtual laboratories are for the interactive laboratory practice through the Internet. Engineering related education is laboratory intensive so that virtual student laboratories are required.

Courses are available as pre configured packages with electives or individually configured student packages. Pre configured packages include options for teaching procedures, credits and virtual laboratory activities.

Individually configured courses can be defined by students or employers and consultants who help students to gain knowledge and experience for the next step on their career. Relevancy and irrelevancy of lower level course elements are taken into account. Irrelevant lower level course elements can not be selected. Individually configured packages are analyzed from the point of view of credits.

On the other hand, any other course elements can be given for students individually, for their request but with no credit points. In this third case, prerequisites are not analyzed. Teaching activities are activated interactively. Students are registered and their performance is measured continuously. Level of entry for students in the system is free choice but credit is only given in case of fulfilled prerequisites.

3. Classroom model

Classroom model is based on computer representation of its component objects (Figure 1.) as virtual classroom model features. It includes structure descriptions as well as associativity definitions between entities or their attributes. Each virtual classroom implementation includes appropriately composed sets of classroom features.

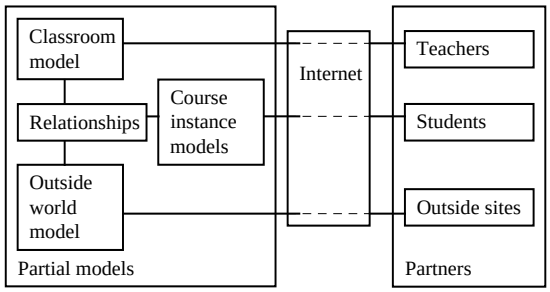

Figure 2. Partial models in integrated classroom model

The main structure of the model is constituted by three partial models integrated by using of relationships (Figure 2). Relationships represent associativities between entities or

their attributes. Classroom model, course instance model and outside world model communicate teachers, students and outside sites, respectively through the Internet.

Attributes of the application oriented virtual classroom entities are defined for example as type, modification and parameters. Multiple application of an entity in the model is allowed without its duplication.

Course feature instance is for a student request. At the same time a student may have multiple course instances. Course feature instance is generated on the appropriate level of model according to the student request. It can be a complex structure or even a single topic. Topic feature as a basic unit of course feature consists of concept, method, implementation, equipment and opinion entities associated with teaching material and publication entities. Assessments are modeled as submitted works, on line exams or conventional exams.

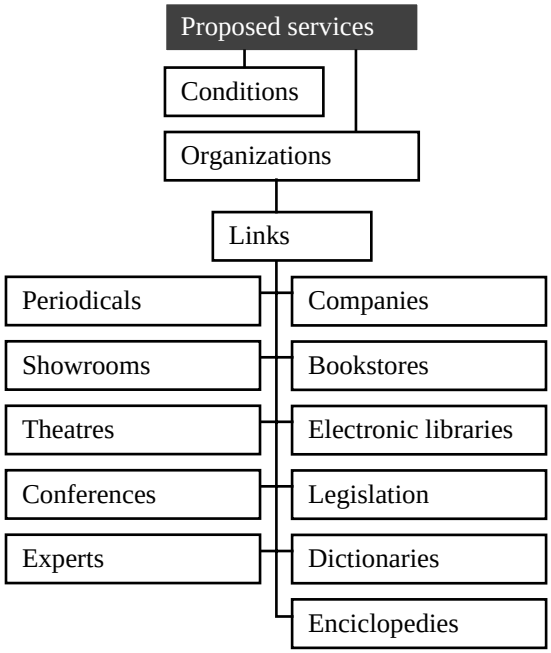

Figure 3. Partial model of the outside world

Teaching procedures are relied upon services offered by the virtual classroom for students. Services are defined as virtual lecture, seminar or laboratory, teaching material service, off line and live consultation, submission in writing as assignments, interactive learning and programmed training. Service procedures use the modeling environment.

Curriculum has to be fully covered by included knowledge representations or referred knowledge sources. This is why partial model of the outside world (Figure 3) is of outstanding importance. One of the main strength of a virtual classroom is the ability to organize outside teaching resources in Internet based course programs. This is that conventional higher education procedures do not able to do. It is impossible to reproduce the knowledge and experience generated in the ever changing world of industrial related practice including research and development.

4. Virtual University Procedures

According to the above mentioned, there are two options for students. They can make use of pre configured courses or they are free to choose any element of the offered teaching programme. Classroom procedures are governed by course instance. Course instance can be absolved with any sequence of its elements. However, prerequisites are act as constraints. Some services are restricted in quantity or time period. Overloaded services may require waiting. To avoid this situation, restricted services can be scheduled on the basis of resources and launched student demands. This makes it possible to choose on-time return by students.

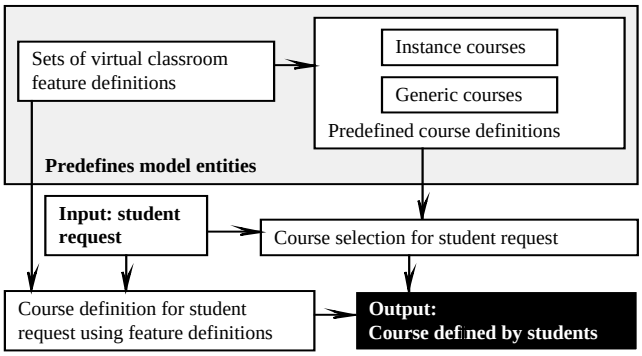

Figure 4. Selection or definition of course instance

Selection and definition of courses (Figure 4.) are done using predefined course or course element definitions. These entities are available in the modeling system. Generic courses describe a set of similar courses. Course elements can be arranged in network to be evaluated to gain course instance. Sometimes simple precedence rules can be used to create instances.

Previously decided relationships and fixed entities, links and attribute values are represented in the classroom model as constraints (Figure 5.). Constraints may be defined by any participants of the higher education system. Legislation and government act through higher education related laws, etc. Accreditation related constraints are necessary for degrees. Internal measures within an institute control teaching activities in virtual classrooms. Teachers define requirements mainly within modules. Prospective or actual employers of students may also define constraints. Finally,

students define what they would learn within a restricted area. The sequence in Figure 5. also represent a hierarchy.

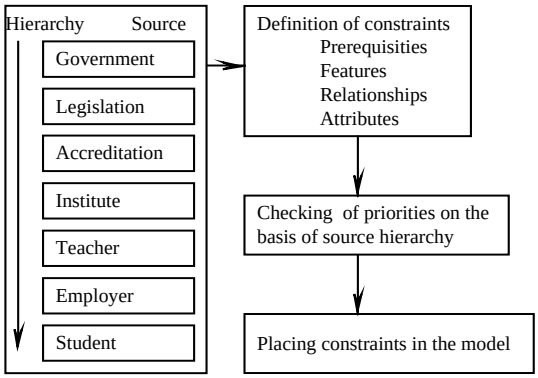

Figure 5. Constraints in classroom model

Constraints in the model are placed on request of their sources taking into account the hierarchy of sources.

5. Implementation and Application Issues

Modeling activities in digital university environments are done by using of appropriate modeling tools on the basis of an Internet portal. Models are stored in data base.

Some activities other than the classroom related ones should also be included in the system. Fortunately, these are basically the same as in other Internet based systems. The most important ones are privacy, copyright and payment. Internet access and interaction with outside information sources can make virtual classroom to a multi-institutional system. On-line, collaborative project and degree works can be organized.

Privacy policy is inevitable. It is illegal for students to send materials to a third person unless one have permission of the author. At the same time all student related personal information must be handled confidential. All content on the virtual classroom site, including text, graphics, software, sounds, music, and video can be protected by copyright, trademark, patent, etc.

6. Conclusions

Virtual classroom can be composed by using of objects appropriate for advanced model description. Model features, structures, relationships and constraints can be defined as elements of advanced virtual classroom models. Constraints may be defined by any participants in the hierarchy of the higher education scenario. Students must have the highest possible freedom in configuration of course instances.

7. References

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